

Appl. No. 10/820,855
Amendment dated: August 8, 2006
Reply to OA of: April 11, 2006

REMARKS

This is in response to the Official Action of April 11, 2006 in connection with the above-identified application.

Applicants would like to begin by respectfully requesting that the Examiner in charge of the instant application acknowledge on the next Office Action Summary the claim for foreign priority in the instant application and receipt of certified copies of the priority documents, as well as indicate if there are any objections to the formal drawings.

Applicants have amended the specification in order to correct minor typographical, grammatical and inconsistency errors appearing in the original application. Firstly, with respect to paragraph [0009], Applicants have amended line 4 of page 4 to recite a second barrier layer. Further, Applicants have amended line 7 of page 4 to recite a second barrier layer comprising tin and nickel, rather than tin and copper. Copper was erroneously recited in place of nickel, as can be supported by the remainder of the sentence, which states that the quantity of nickel is larger than that of tin.

With respect to paragraph [0018], Applicants have amended the paragraph to more clearly recite which materials may be used for the different layers of the instant invention. The original application recited that the adhesive layer, first barrier layer and wetting layer could each comprise any of a variety of different specified materials. However, Applicants respectfully submit that this recitation represents an obvious but inadvertent error, as only some of the materials are suitable for the different layers. Thus, Applicants have replaced the original listing of materials suitable for all of the layers with a listing that more clearly sets forth which materials are suitable for which layers. As can be seen by comparing the original paragraph [0018] with amended paragraph [0018], the order in which the materials are recited is maintained, only now each subset of materials is more clearly linked to the specific layer. Applicants respectfully submit that this further serves as evidence that Applicants intended to assign a subset of materials to a specific layer, but inadvertently failed to do so. Thus,

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Applicants respectfully submit that this amendment to paragraph [0018] does not introduce new matter into the application.

With respect to paragraph [0023], Applicants have amended this paragraph to recite that the first electrically conductive layer 306a may comprise a titanium layer, an aluminum layer, a nickel-vanadium alloy layer or a copper layer, that the titanium layer is directly attached to a plurality of bonding pads 304 and that the material of the first electrically conductive layer 306a is selected from the group of aluminum, titanium, titanium-vanadium alloy, titanium-tungsten alloy, copper, nickel-copper alloy, nickel and nickel-vanadium alloy. Support for this amendment may be found at, e.g., original claims 13 and 14. Further, Applicants have amended this paragraph to recite a second electrically conductive layer that comprises tin and nickel, rather than lead. This amendment may be supported by original claim 8. Paragraph [0023] has also been amended to recite that the thickness of the second electrically conductive layer is ranged from about 50 μm to 80 μm , as supported by original claims 7 and 17.

Applicants respectfully submit that none of the amendments to the specification introduce new matter into the application.

Applicants have also amended the claims of the instant application in order to more precisely define the scope of the present invention, taking into consideration the outstanding Official Action. Claims 3 and 8 have been amended to recite that the layers comprise certain materials. These amendments are clearly supported by the specification as originally filed (see, e.g., paragraph [0018]). Claim 6 has been amended to recite that the adhesive layer comprises titanium, as supported in the originally filed specification (see, e.g., paragraph [0018]). Further, Applicants note that claims 15 and 18 have been amended to depend from claim 11 rather than claim 8. Claim 17 has been amended to recite that the thickness of the second electrically conductive layer is ranged from about 50 μm to 80 μm , as supported by the specification as originally filed. Finally, Applicants note that claims 5 and 19 have been cancelled without prejudice or disclaimer. Applicants reserve the rights to file a continuation application directed to the subject matter of the canceled claims.

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Applicants respectfully submit that no new matter has been introduced into the application by the amendments to the claims and that all claims now pending in the instant application are in full compliance with the requirements of 35 U.S.C. §112.

Turning now the Official Action, Applicants note that claim 17 has been rejected under 35 U.S.C. §112, first paragraph because the specification does not provide enablement for the subject matter recited claim 17. Accordingly, Applicants have amended claim 17 to recite that the second electrically conductive layer has a thickness ranged from about 50 to 80 μm , as clearly supported by the originally filed specification. The second electrically conductive layer of the second embodiment is analogous to the second barrier layer in the first embodiment, and the amendment to claim 17 is therefore supported by original claim 7 and paragraph [0019]. Accordingly, it is respectfully requested that this rejection be withdrawn.

Claim 6 has been objected to because the Official Action urges that the specification does not teach that the wetting layer comprises titanium. Applicants note that claims 6 has been amended to recite that the adhesive layer comprises titanium, as clearly supported in the specification as originally filed (see, e.g., paragraph [0018]). In light of this amendment, Applicants respectfully submit that the objection to claim 6 has been rendered moot, and should therefore be withdrawn.

Turning now to the prior art rejections, the rejection of claims 1-5 under 35 U.S.C. §103(a) as being unpatentable over Applicants Admitted Prior Art (AAPA) in view of Liu et al. (US Pat. No. 6,744,142) and the rejection of claims 6 and 7 under 35 U.S.C. §103(a) as being unpatentable over APPA in view of Lie and further in view of Wang (US Pat. No. 6,782,897) have each been carefully considered but are most respectfully traversed in light of the following comments.

Applicants wish to direct the Examiner's attention to the basic requirements of a prima facie case of obviousness as set forth in the MPEP § 2143. This section states that to establish a prima facie case of obviousness, three basic criteria first must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to

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modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Section 2143.03 states that all claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

Applicants also note MPEP §2143.01, which states in part that, if a proposed modification would render the prior art invention unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

Applicants also most respectfully direct the Examiner's attention to MPEP § 2144.08 (page 2100-114) wherein it is stated that Office personnel should consider all rebuttal argument and evidence presented by applicant and the citation of In re Soni for error in not considering evidence presented in the specification.

The Official Action urges that AAPA discloses a under bump metallization (UBM) structure as recited in claim 1 of the instant application, with the exception of disclosing a second barrier layer disposed on the wetting layer. In order to address this deficiency, the Official Action urges that Liu discloses a barrier layer formed of tin and nickel on a wetting layer and that it would be obvious to modify AAPA based upon the teaching of Liu in order to prevent spalling of the UBM layer. Applicants respectfully traverse this rejection.

Firstly, Applicants note that composite intermetallic compound 218 is the first and only barrier layer disclosed in the UBM of Liu. That is to say, Liu discloses a chromium

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adhesion layer 206a and a nickel layer 206b, with a composite intermetallic composite compound 218 formed between the solder material 208a and the nickel layer 206b after the solder material has reflowed. There is absolutely no disclosure in Liu of a second barrier layer as recited in the instant application. Accordingly, Applicants respectfully submit that Liu fails to disclose a second barrier layer comprising tin and nickel as recited in claim 1.

It is respectfully asserted that while one of ordinary skill in the art may be motivated to substitute the barrier layer of Liu with the barrier layer of AAPA, there is absolutely no suggestion in either reference for having two barrier layers. One would not be motivated to add another barrier layer to the structure of AAPA when the structure of AAPA already has a barrier layer and there is no motivation provided in the references to have two barrier layers. Applicants therefore respectfully request that this rejection be withdrawn.

Further, Applicants note that the only way in which the composite intermetallic compound 218 of Liu is formed is through a process wherein the tin-containing solder material is reflowed, causing the nickel in the nickel layer and the tin of the tin-containing solder material to react such that a Ni-Sn intermetallic compound is formed. In other words, Liu does not simply disclose a Ni-Sn layer, but rather discloses the formation of a Ni-Sn layer that requires processing of the solder material and reaction with a nickel layer. Accordingly, it is respectfully submitted that the disclosure of a Ni-Sn intermetallic compound in Liu cannot be separated from the teaching of the process needed to form the layer. The only way to properly incorporate the teaching of Liu into AAPA would be to also modify AAPA with the method of forming the Ni-Sn layer disclosed in Liu, i.e., reflowing a tin-containing solder material such that the tin reacts with the nickel of a top UBM layer. As there is clearly no motivation to make this drastic modification, Applicants respectfully submit that the combination of Liu and AAPA fail to disclose or suggest every element of the claimed invention. Accordingly, Applicants respectfully request that this rejection be withdrawn.

Applicants also note that the formation of the Ni-Sn intermetallic compound of

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Liu does not occur until after the solder material is reflowed. That is to say, Liu requires that the solder material be reflowed to cause the reaction between the solder material and the top layer of the UBM in order to form the Ni-Sn layer. To the contrary, the second barrier layer recited in the instant claims must be present before the solder material is reflowed in order to achieve the intended purpose of the present invention. When the solder material formed on the already-existing second barrier layer is reflowed, the tin provided in the solder material first reacts with nickel of the second barrier layer that is not fully reacted with the tin of the second barrier layer to securely attach the solder material to the UBM. Additionally, due in part to the low ratio of tin in the second barrier layer, the tin is not easily reacted with the copper of the barrier layer or the nickel in the first barrier layer. Thus, the presently claimed invention is further differentiated from the prior art references.

For all of the foregoing reasons, Applicants respectfully submit that a *prima facie* case of obviousness according to the guidelines set forth in MPEP §2143 has not been established. Accordingly, Applicants respectfully request that the rejection of claim 1 and all claims depending therefrom over AAPA in view of Liu be withdrawn.

With respect to the rejection of claim 6 and 7 over AAPA, Liu and Wang, Applicants note that the basis for the rejection is the rejection of claims 1-5 as being unpatentable over AAPA and Liu. Therefore, the rejection of claims 6 and 7 is deficient for all of the same reasons identified above with respect to the rejection of claim 1 over AAPA and Liu. Further, it is respectfully submitted that teachings of Wang fail to remedy any of the deficiencies identified above. Thus, as neither, AAPA, Liu nor Wang, either standing alone or taken in combination, disclose or suggest every element of the claimed invention, Applicants respectfully request that this rejection be withdrawn.

The rejection of claims 8-13, 15, 16 and 19 under 35 U.S.C. §103(a) as being unpatentable over Liu, the rejection of claim 14 under 35 U.S.C. §103(a) as being unpatentable over Liu in view of Tong (US Pub. App. No. 2003/0189260) and the rejection of claims 17 and 18 under 35 U.S.C. §103(a) as being unpatentable over Liu in view of Wang have each been carefully considered but are most respectfully

traversed in light of the following comments.

The Official Action urges that, with respect to claim 8, Liu discloses a semiconductor wafer as recited in claim 8, including a plurality of bonding pads, a first electrically conductive layer 206b and a second electrically conductive layer 218 of tin-nickel. The Official Action urges that the structure disclosed in Liu impliedly discloses an active surface. Applicants respectfully traverse this rejection for the following reasons.

Firstly, Applicants note the limitation in the claims that the first electrically conductive layer is formed on the bonding pads. This is clearly illustrated in, e.g., Figure 3A, wherein first electrically conductive layer 306a is formed on bonding pad 304. To the contrary, the nickel layer 206b of Liu is not formed on the bonding pad 202. Rather, the nickel layer 206b is formed on chromium adhesion layer 206a, and chromium adhesion layer 206b is formed on the bonding pad. There is no direct contact between the bonding pad 202 and the nickel layer 206b, and therefore nickel layer 206b is not formed on the bonding pads as recited in claim 8 of the instant application. Accordingly, Applicants respectfully submit that Liu fails to establish a proper §103(a) rejection according to the guidelines set forth in MPEP §2143 and should therefore be withdrawn.

Furthermore, as discussed above with respect to the §103(a) rejection of claim 1, Applicants note that the nickel-containing intermetallic compound 218 of Liu is only formed by the reaction of the tin-containing solder material and the nickel layer when the solder material is reflowed. In other words, a layer of Ni-Sn is not deposited on the top nickel layer of the UBM layer 206, but rather, is formed after the solder material has been deposited on the nickel layer 206b and the solder material has been reflowed. Thus, Liu discloses that in order to have a Ni-Sn layer between the nickel layer 206b and the tin-containing solder material, a reaction between these two layers must take place. To the contrary, the instant application requires no such reaction between layers, and in fact expressly requires that a second electrically conductive layer comprising tin and nickel be formed before the solder material is deposited when

considering the limitations recited in claims 8 and 9.

Ultimately, the second electrically conductive layer recited in the instant claims must be present before the solder material is reflowed in order to achieve the intended purpose of the present invention. Thus, the presently claimed invention is further differentiated from the prior art references.

For all of the foregoing reasons, Applicants respectfully submit that Liu fails to disclose or suggest every element of the presently claimed invention and is therefore incapable of establishing a *prima facie* case of obviousness according to the guidelines set forth in MPEP §2143. Applicants therefore respectfully request that the rejection of claim 8 and all claims depending therefrom be withdrawn.

With respect to claim 11, the Official Action urges that Liu discloses a dielectric layer 214 that covers the second electrically conductive layer and exposes a portion of the second electrically conductive layer as shown in Figure 4. However, Applicants respectfully submit that Liu fails to disclose a dielectric layer that covers the second electrically conductive layer. The feature of a second electrically conductive layer covered by dielectric layer is illustrated in, e.g., Figure 3B of the instant application. The second electrically conductive layer 310b is covered by dielectric layer 312, i.e., the dielectric layer is formed on top of the second electrically conductive layer. An opening in the dielectric layer is provided over a portion of the second electrically conductive layer, but the majority of the second electrically conductive layer is covered by the dielectric layer.

To the contrary, Liu clearly fails to disclose a dielectric layer that covers the second electrically conductive layer. As shown in Figure 4 of Liu, the Ni-Sn intermetallic compound 218 is only covered by the tin-containing solder material 208. The dielectric layer 214 is only located to the sides of the Ni-Sn intermetallic compound 218 and no portion of the dielectric layer is over or covering the Ni-Sn intermetallic compound. In fact, because the Ni-Sn intermetallic compound 218 is formed by the reaction between the tin-containing solder material 208 and the nickel layer 206b, it follows that the Ni-Sn intermetallic compound 218 may only be formed between the solder material 208 and

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the nickel layer 206b and can only be covered by the solder material 208. Accordingly, Applicants respectfully submit that Liu fails to disclose or suggest this specific feature of the claimed invention and therefore cannot properly support a §103a rejection of claim 11 according to the guidelines set forth in MPEP §2143. Applicants therefore respectfully request that this rejection be withdrawn.

With respect to the rejection of claim 14 as being unpatentable over Liu in view of Tong, the Official Action urges that it would have been obvious based upon the teaching of Tong to modify the material of the first electrically conductive layer (i.e., the nickel layer) of Liu to be titanium or a titanium-tungsten alloy because these materials are "known of this usage". Applicants specifically traverse this rejection.

Specifically, Applicants assert that Liu teaches away from the proposed modification. It is obvious from a careful reading of Liu that the layer 206b must be nickel in order to form the Ni-Sn intermetallic compound 218 between the nickel layer 206b and the solder material 208. As described in detail above, the tin-containing solder material located over the nickel layer 206b is reflowed to form a Ni-Sn intermetallic layer between the solder material and the nickel layer. As expressly acknowledged in the Official Action, the Ni-Sn intermetallic layer serves to prevent spalling of the UBM layer, and is therefore an important feature of the disclosed invention. If the material of the nickel layer 206b were modified as proposed in the Official Action, the structure would be incapable of forming a Ni-Sn intermetallic layer between the solder material and the layer 206b because the modification would replace the source of the nickel for the Ni-Sn intermetallic layer with a titanium or titanium-tungsten alloy. Therefore, the proposed modification would make the invention unsuitable for its intended purpose.

Accordingly, Applicants respectfully submit that the rejection of claim 14 over Liu and Tong fails to properly establish a prima facie case of obviousness according to the guidelines set forth in MPEP §2143 and should therefore be withdrawn.

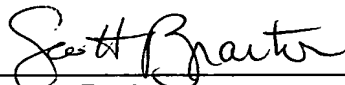
Finally, with respect to the §103(a) rejection of claims 17 and 18 as being unpatentable over Liu in view of Wang, Applicants note that the basis for the rejection

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of claims 17 and 18 is the §103(a) rejection of claim 8 over Liu. As discussed above, the rejection of claim 8 over Liu is deficient, and therefore these deficiencies are also present in the rejection of claims 17 and 18. Further, Applicants respectfully submit that Wang fails to remedy the identified deficiencies in the rejection of claim 8. Accordingly, as neither Liu nor Wang, either standing alone or taken in combination, disclose or suggest every element of the claimed invention, Applicants respectfully submit that a proper §103(a) rejection according to the guidelines set forth in MPEP §2143 has not been established, and the rejection should therefore be withdrawn.

In view of the above comments and further amendments to the claims, favorable reconsideration and allowance of all of the claims now present in the application are most respectfully requested.

Respectfully submitted,
BACON & THOMAS, PLLC

By: 

Scott A. Brairton
Registration No. 55,020

625 Slaters Lane, 4th Fl.
Alexandria, Virginia 22314
Phone: (703) 683-0500
Facsimile: (703) 683-1080

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A01.wpd

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